

REMARKS

Now in the application are Claims 1-18, of which Claims 1, 8, 11, and 15 are independent. This Amendment amends Claim 14 to address a typographical error. The amendment presents no new matter and they present no new issues. Thus, consideration of the proposed amendments requires no further search. The following comments address all stated grounds for rejection, and place the presently pending claims, as identified above, in condition for allowance.

Claim Objections:

Applicants amend Claim 14 to remove the repeat occurrence of the phrase "a relative speed". Applicants amendment to Claim 14 corrects a typographical error and does not address any art rejection. With this amendment, Applicants respectfully request the Examiner to reconsider and withdraw the objection to Claim 14.

Claim Rejections under 35 U.S.C. Section 103**IA. Rejection of Claims 1, 11-13, 15, and 16 under 35 U.S.C. Section 103(a):**

The Office Action rejects Claims 1, 11-13, 15, and 16 as being unpatentable over U.S. Patent No. 6,041,274 of Onishi, *et al.* (hereinafter "Onishi") in view of U.S. Patent No. 6,487,303 of Yamaguchi, *et al.* (hereinafter "Yamaguchi"). Applicants respectfully traverse this rejection on the basis of the following arguments, and further contend that neither Onishi, nor Yamaguchi, alone or in combination, teach or suggest each and every element of these claims, as described below, and hence, does not detract from the patentability of the claimed invention.

Summary of the Claimed Invention

Applicants' invention is directed to object recognition systems and object recognition methods for recognizing an object in front of a vehicle. Each system and method is capable of recognizing objects using a plurality of windows in images captured using one or more sensors mounted on a vehicle. The object recognition systems and object recognition methods of Applicants' invention address the recognition errors caused

by measurement errors introduced due to a vehicle's pitch or roll when a vehicle travels up a grade or down a grade, or when the attachment point or the installation angle of the camera changes from an initially installed position.

Summary of the Onishi Patent

The Onishi patent is concerned with improving the positioning of a mobile robot at various workstations the robot travels to. That is, the Onishi patent teaches the use of indicia placed or embedded in a floor specifically to facilitate reading by the robot. The embedded indicia are not intended to be read by humans. The robot reads the indicia by imaging the floor and accordingly determines a positional offset relative to a prior positioning. Furthermore, the system of Onishi includes a teaching phase and a working phase for processing an image to be picked up at a predetermined stop at a workstation.

Summary of the Yamaguchi Patent

The Yamaguchi patent discloses an object detector for distinguishing between a road of travel and an obstacle in an image using a distance image when a vehicle is traveling.

The Claimed Invention Distinguishes Patentability Over The Cited References

Claims 1, 11-13, 15, and 16 are not rendered obvious by the cited Onishi patent nor the cited Yamaguchi patent, alone or in combination. Claims 1, 11, and 15, recite an object recognition system, an object recognition method, and an object recognition system, respectively, that compare measured distances for each window of a captured image with an estimated distance to the road surface for each window to determine if the measured distances corresponds to the road surface. Each claimed object recognition system and object recognition method further estimate inclination of the vehicle based on the measured distances that are determined to correspond to the road surface. Accordingly, based on such estimated inclination, the estimated distances are modified.

Claims 12 and 13 depend, directly or indirectly, from Claim 11 and thereby incorporate the novel features of Claim 11. Claim 16 depends from Claim 15 and

therefore incorporates the novel features of Claim 16. Accordingly, the arguments asserted below with respect to independent Claims 1, 11, and 15 are equally applicable to each corresponding dependent claim.

The Onishi patent does not teach or suggest an object recognition system mounted to a vehicle that compares measured distances from each window in a captured image of a road surface with an estimated distance to the road surface for each window to determine if the measured distance corresponds to the road surface. Further, the Onishi patent fails to teach or suggest an object recognition method for recognizing an object in front of a vehicle that includes a step of comparing for each of a plurality of windows a measured distance with an estimated distance to determine if the measured distance belongs to the road surface. Moreover, the Onishi patent teaches a training phase and a working phase in order to recognize a position of the robot at each workstation stop. Applicants claimed invention is not limited to recognizing an image at a predetermined position, rather the claimed invention processes images in a real-time format as the vehicle travels along a road even when the vehicle travels the road for the first time. Applicants respectfully note the Examiner recognizes that the Onishi reference fails to expressly disclose that the imaged surface is a road surface.

The Yamaguchi patent is cited as teaching or suggesting that the imaged surface is a road surface. Nevertheless, the Yamaguchi patent fails to teach or suggest comparing measured distances from each window in a captured image of a road surface with an estimated distance to the road surface for each window to determine if the measured distances correspond to the road surface. The Yamaguchi patent, in contrast to Claims 1, 11-13, 15, and 16, compares pixels from two images to determine a distance image and derives a road surface from the distance image by determining a two-dimensional distribution of pixels in the distance image. Yamaguchi does not compare measured distances for each window in a captured image of a road surface with an estimated distance to the road surface for each window to determine if the measured distances correspond to the road surface. Furthermore, Yamaguchi does not estimate an inclination of the vehicle based on the measured distances that are determined to correspond to the road surface and use the estimated inclination to in turn modify the estimated distances.

In contrast to the cited references, Claim 1 recites an object recognition system mounted on a vehicle having, amongst other features, means for comparing, for each of the plurality of the windows, the measured distance with the estimated distance to determine if the measured distance belongs to the road surface. Likewise, Claims 15 and 16 recite object recognition systems mounted on a vehicle for recognizing an object in front of a vehicle by comparing a measured distance with an estimated distance to determine if the measured distance belong to the road surface. Furthermore, Claims 11, 12 and 13 recite an object recognition method for recognizing an object in front of a vehicle by, in addition to other steps, comparing for each window of an image, a measured distance with an estimated distance to determine if the measured distance belongs to the road. Neither the Onishi patent nor the Yamaguchi patent, alone or in combination, teach or suggest comparing, for each of a plurality of windows, a measured distance with an estimated distance to determine if the measured distance belongs to the road surface.

Specifically, the Onishi patent teaches the comparison between two sets of actual measured distances to determine an offset to account for positioning errors of the mobile robot at various workstations. The Onishi patent does not teach or suggest the use of *estimated distance* data for comparison with actual measured distance data to determine if the measured distance belongs to a road surface. The Yamaguchi patent fails to bridge the factual deficiencies of the Onishi patent because the Yamaguchi patent does not compare a measured distance for each window in a captured image of a road surface with an *estimated distance* to the road surface for each window to determine if the measured distance corresponds to the road surface. Hence, neither the Onishi patent nor the Yamaguchi patent, alone or in combination, teach or suggest each and every element in Claims 1, 11, 12, 13, 15, and 16. As such, the Onishi patent in view of the Yamaguchi patent does not detract from the patentability of these claims.

Consequently, the system of Claim 1; the method of Claim 11; and the system of Claim 15 are not rendered obvious by the Onishi patent in view of Yamaguchi patent. Accordingly, Applicants' request the Examiner to reconsider and withdraw the rejection of Claims 1, 11-13, 15, and 16 under 35 U.S.C. §103.

IB. Rejection of Claims 2-10, 14, 17 and 18 under 35 U.S.C. Section 103(a):

The Office Action rejects Claims 2-10, 14, 17 and 18 as being unpatentable over the Onishi patent in view of the Yamaguchi patent and in further view of U.S. Patent No. 5,638,116 of Shimoura, *et al.* (hereinafter "Shimoura"). Applicants respectfully traverse this rejection on the basis of the following arguments, and further contend that the combination of Onishi in view of Yamaguchi and in further view of Shimoura fail to teach or suggest all elements of these claims, as described below, and hence, does not obviate the claimed invention.

Summary of the Shimoura Reference

The Shimoura reference is directed to an object recognition apparatus that relies upon a single point in an image, that is, the vanishing point, to determine the pitch, roll, and yaw of a vehicle on a roadway. The vanishing point is defined as the point at which the road vanishes in a captured image. *See*, Column 16, lines 3 and 4, of Shimoura.

The Claimed Invention Distinguishes Patentability Over The Cited References

Claims 2- 7 depend, directly or indirectly from Claim 1 and thereby incorporate the novel features of Claim 1. Claim 8 recites a means for comparing that compares a measured distance with an estimated distance for each window in a captured image of an object. Claims 9 and 10 depend from Claim 8 and therefore incorporate the novel features of Claim 8. Claim 14 depends, directly or indirectly, on Claim 11 and hence, therefore incorporates the novel features of Claim 11. Claims 17 and 18 depend, directly or indirectly, on Claim 15 and thereby incorporate the novel features of Claim 15.

As discussed above neither the Onishi patent nor the Yamaguchi patent, alone or in combination, teach or suggest each and every element of independent Claims 1, 11, and 15. The Shimoura reference fails to bridge the factual deficiencies of the Onishi patent and the Yamaguchi patent. Shimoura relies upon a single point in an image, that is, the vanishing point, to determine the pitch, roll, and yaw of a vehicle on a roadway. Neither the Onishi patent nor the Yamaguchi patent nor the Shimoura patent teach or suggest a system or method for recognizing an object in front of a vehicle that compares measured distances for each window in a captured image of a road surface with an

estimated distance to the road surface for each window to determine if the measured distances corresponds to the road surface.

Accordingly, neither the Onishi patent, nor the Yamaguchi patent, nor the Shimoura patent, alone or in any combination, detract from the patentability of Claims 2-10, 14, 17 and 18 because each cited reference, alone or in any combination, fails to teach or suggest each and every element found in these claims.

Moreover, it appears that Shimoura patent teaches or suggests an operation distinct from the Yamaguchi patent that if combined would change the operation of the Yamaguchi patent. The Shimoura patent teaches the averaging of a number of road vanishing points to provide the yaw angle and pitch angle of a vehicle. *See*, column 30, lines 15 – 21 of the Shimoura patent. In contrast, the Yamaguchi patent teaches an operation to determine pitch in a captured image that plots a distance value for each pixel or groups of pixels in an image to determine a distribution of distances and then searching the distribution for those pixels the bottom point (points having the smallest Z value) in each region of the distribution. *See*, Column 7, lines 37-45 of Yamaguchi. Accordingly, Yamaguchi teaches a principle of operation and construction that requires a plurality of points taken from all regions of an image to determine an inclination while, in contrast, the Shimoura patent teaches an operation and construction that uses a point or points taken from a highly distinct region, specifically, the vanishing point of a captured image. Hence, the Examiner's proposed modification of the Yamaguchi patent in view of the Shimoura patent changes the principle of operation of the Yamaguchi patent and therefore provides no motivation for one skilled in the art to combine references.

Accordingly, neither the Onishi patent, nor the Yamaguchi patent, nor the Shimoura patent, alone or in any combination, fail to establish a *prima facie* case of obviousness to detract from the patentability of Claims 2-10, 14, 17 and 18. Neither the Onishi patent, nor the Yamaguchi patent nor the Shimoura patent, alone or in any combination, teach or suggest each and every element of Claims 2-10, 14, 17 and 18. Further, the cited combination of references lacks any motivation to combine for the proposed modification or combination of the prior art would change the principle of operation of the prior art invention being modified. Hence, Applicants' respectfully

request the Examiner to reconsider and withdraw the rejection of Claims 2-10, 14, 17 and 18 under 35 U.S.C. §103.

CONCLUSION

For the foregoing reasons, Applicants contend that Claims 1-18 define over the cited art. If there are any remaining issues, an opportunity for an interview is requested prior to the issuance of another Office Action. If the above arguments are not deemed to place this case in condition for allowance, the Examiner is urged to call Applicants' representative at the telephone number listed below.

Respectfully submitted,
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